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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is used, for example as driving sources, such as a car, and relates to the fuel cell system which supplies fuel gas to hydrogen gas and the fuel cell which generates electricity by supplying air as oxidant gas as fuel gas.

[0002]

[Description of the Prior Art]As a hydrogen supply system to the conventional fuel cell, what was indicated by JP,9-22714,A, for example is known.

[0003]It recycles by making this JP,9-22714,A circulate through the fuel gas discharged from the fuel cell stack, hydrogen containing many hydrogen newly supplied from the outside -- in order to generate electricity by supplying the fuel electrode of a fuel cell after mixing the hydrogen gas through which it circulated to rich fuel gas, having adopted the ejector pump is indicated.

[0004]

[Problem(s) to be Solved by the Invention]However, the hydrogen supply system to said conventional fuel cell is premised on the use for a stationary fuel cell in many cases. It is necessary to supply mass hydrogen in an instant, for example at the times at the time of the re-acceleration and sudden acceleration after accelerator-off, etc., and in this hydrogen supply system, if it is going to use it as an object for vehicle running, in order to pass the inside of a hydrogen circulation ejector by few pressure losses as much as possible, it is necessary to use the ejector nozzle of a large caliber.

[0005]On the other hand, in order that a hydrogen circulation ejector may obtain circulation negative pressure, when it is necessary to acquire the fluid rate of flow beyond constant value and the ejector nozzle of a large caliber is adopted, it may become impossible to obtain the hydrogen circulation performance at the time of the low flow rate circulation at the time of idling

stop and a regular run at a low speed, etc. That is, there was a problem that it might be said that the conventional hydrogen supply system is difficult to acquire the fluid rate of flow beyond the constant value for obtaining circulation negative pressure, and the response demanded as an object for vehicles is not materialized.

[0006]Generally, at the time of a heavy load, since it is easy to obtain a voltage output with the big one where the hydrostatic pressure of hydrogen gas is higher, it is in the tendency which makes hydrogen gas pressure high, and at the time of low loading, in order to make driving loss by a compressor into the minimum, it is in the tendency which makes hydrogen gas pressure low in many cases.

[0007]There was a problem that a great transient flow required in order to switch a response to high load operation well from low load driving at this time, to combine with a regular consumption flow rate and to increase hydrogen gas pressure was required, and reservation of load responsiveness was difficult.

[0008]Then, this invention is proposed in view of the actual condition mentioned above, and is a thing.

The purpose is to provide the fuel cell system which does not have to enlarge the nozzle diameter for supplying in consideration of the time of a transitional large flow rate, and can supply fuel gas with a sufficient response to a fuel cell.

[0009]

[Means for Solving the Problem]A fuel cell system concerning this invention is provided with the following.

A fuel cell which fuel gas is supplied to the above-mentioned fuel electrode side, and is generated while being constituted by an oxidizing agent pole and fuel electrode on both sides of an electrolyte membrane and supplying oxidant gas to the above-mentioned oxidizing agent pole side, in order to solve above-mentioned SUBJECT.

A fuel accumulation means which accumulates fuel gas supplied to a fuel electrode of the above-mentioned fuel cell.

A fuel gas flow route which has a gas pump which supplies again at least a part of fuel gas discharged from the above-mentioned fuel cell to a fuel electrode of said fuel cell while supplying fuel gas to said fuel cell from the above-mentioned fuel accumulation means.

A fuel gas sub passage which has a flow control means which adjusts a flow which fuel gas is supplied from the above-mentioned fuel accumulation means, and is supplied to the above-mentioned fuel cell, and a flow control means which faces supplying fuel gas to the above-mentioned fuel cell from the above-mentioned fuel accumulation means, and controls a fuel gas flow of the above-mentioned fuel gas flow route and a fuel gas sub passage.

[0010]As for the above-mentioned fuel gas sub passage, in a fuel cell system concerning this invention, it is desirable to open a fuel gas supply side of the above-mentioned gas pump and the fuel gas discharge side of the above-mentioned gas pump for free passage, and to establish the above-mentioned flow control means between a fuel gas supply side and the fuel gas discharge side of the above-mentioned gas pump.

[0011]In a fuel cell system concerning this invention, the above-mentioned flow control means may control a flow of the above-mentioned fuel gas sub passage based on a pressure differential of a target pressure value of fuel gas supplied to the above-mentioned fuel cell, and a present pressure value of fuel gas currently supplied to the above-mentioned fuel cell.

[0012]In a fuel cell system concerning this invention again the above-mentioned flow control means, Based on a pressure differential of a target pressure value of fuel gas supplied to the above-mentioned fuel cell, and a present pressure value of fuel gas currently supplied to the above-mentioned fuel cell, and a present pressure value currently supplied to the above-mentioned fuel cell, a flow of the above-mentioned fuel gas sub passage may be controlled.

[0013]In a fuel cell system concerning this invention, the above-mentioned flow control means may control a flow of the above-mentioned fuel gas sub passage again based on a pressure differential of a pressure value of fuel gas supplied to the above-mentioned gas pump, and a present pressure value of fuel gas currently supplied to the above-mentioned fuel cell.

[0014]In a fuel cell system concerning this invention again the above-mentioned flow control means, Based on a pressure differential of a pressure value of fuel gas supplied to the above-mentioned gas pump, and a present pressure value of fuel gas currently supplied to the above-mentioned fuel cell, and a present pressure value of fuel gas currently supplied to the above-mentioned fuel cell, a flow of the above-mentioned fuel gas sub passage may be controlled.

[0015]A channel which opens the above-mentioned gas pump and the above-mentioned fuel accumulation means for free passage in a fuel cell system concerning this invention again, And form a pressure regulation means to adjust a pressure of fuel gas in a channel which opens both sides of the above-mentioned gas pump, and the above-mentioned fuel accumulation means of the above-mentioned fuel gas sub passage for free passage, and it synchronizes with flow control timing of the above-mentioned flow control means of the above-mentioned fuel gas sub passage, It is desirable only for a predetermined value to make a setting pressure of the above-mentioned pressure regulation means fluctuate.

[0016]

[Effect of the Invention]Since it faces supplying fuel gas to a fuel cell from fuel cell system ***** concerning claim 1 of this invention, and a fuel accumulation means and the fuel gas flow of a fuel gas flow route and a fuel gas sub passage is controlled, When it is necessary to supply much hydrogen gas to a fuel cell, hydrogen gas of a large flow rate can be supplied to a fuel cell via a fuel gas sub passage, While not enlarging the nozzle diameter of an air pump in

consideration of the time of a transitional large flow rate and being able to supply fuel gas with a sufficient response to a fuel cell, the circulation performance of hydrogen gas at the time of a low flow rate is also fully securable.

[0017]According to the fuel cell system concerning claim 2 of this invention, the fuel gas supply side of a gas pump and the fuel gas discharge side of a gas pump are opened for free passage for a fuel gas sub passage, Since a flow control means is established between a fuel gas supply side and the fuel gas discharge side of a gas pump, a gas pump can be bypassed and fuel gas can be supplied to a fuel cell.

[0018]Since opening and closing of a flow control means are judged according to the pressure differential of a target pressure value and a present pressure value according to the fuel cell system concerning claim 3 of this invention, it can constitute only from forming a pressure sensor in the upper stream which supplies hydrogen gas of a fuel cell, and a system can be constituted cheaply.

[0019]The pressure differential of the target pressure value of the fuel gas which is supplied to a fuel cell again according to the fuel cell system concerning claim 4 of this invention, and the present pressure value of the fuel gas currently supplied to the fuel cell, Since the flow of a fuel gas sub passage is controlled based on the present pressure value currently supplied to the fuel cell, taking the size of mass flow into consideration, opening and closing of the bypass valve 4 can be controlled, and control precision can be raised.

[0020]Since the flow of a fuel gas sub passage is controlled again based on the pressure differential of the pressure value of the fuel gas supplied to a gas pump, and the present pressure value of the fuel gas currently supplied to the fuel cell according to the fuel cell system concerning claim 5 of this invention, It can become controllable according to the pressure loss before and behind a actual gas pump, and control precision can be raised.

[0021]The pressure differential of the pressure value of the fuel gas which is supplied to a gas pump again according to the fuel cell system concerning claim 6 of this invention, and the present pressure value of the fuel gas currently supplied to the fuel cell, Since the flow of a fuel gas sub passage is controlled based on the present pressure value of the fuel gas currently supplied to the fuel cell, Since it becomes possible to control opening and closing of a flow control means, taking the size of mass flow into consideration while becoming controllable according to the pressure loss before and behind a actual gas pump, control precision can be raised further.

[0022]The channel which opens the above-mentioned gas pump and the above-mentioned fuel accumulation means for free passage again according to the fuel cell system concerning claim 7 of this invention, And form a pressure regulation means to adjust the pressure of fuel gas in the channel which opens the both sides or the above-mentioned gas pump, and the above-mentioned fuel accumulation means of the above-mentioned fuel gas sub passage for free

passage, and it synchronizes with the flow control timing of the above-mentioned flow control means of the above-mentioned fuel gas sub passage, Since only a predetermined value makes the setting pressure of the above-mentioned pressure regulation means fluctuate, can perform mass supply and supply interruption of hydrogen gas with a sufficient response, and. A part for the transient change of the regulator pressure resulting from pressure (flow) change of a sub passage, i.e., a fluctuated part of momentary regulator pressure, is controlled, it cancels, and stable control of flow can be realized.

[0023]

[Embodiment of the Invention] Hereafter, an embodiment of the invention is described with reference to drawings.

[0024] This invention is applied to the fuel cell system constituted as shown, for example in drawing 1. Fuel gas is supplied to the above-mentioned fuel electrode side, and the fuel cell with which this fuel cell system is equipped is generated while being constituted by an oxidizing agent pole and the fuel electrode on both sides of an electrolyte membrane and supplying oxidant gas to the above-mentioned oxidizing agent pole side.

[0025] This fuel cell system, Hydrogen used as hydrogen gas. The ejector pump 3 which discharges hydrogen gas from the regulator valve 2, the regulator valve 2, and the fuel cell stack 6 which adjust the pressure of hydrogen gas from the stored fuel storage cylinder 1 and the fuel storage cylinder 1 toward the fuel cell stack 6, It has the bypass valve 4 which hydrogen gas from the regulator valve 2 is supplied, and is led to the fuel cell stack 6, the pressure sensor 5 which detects the pressure of the hydrogen gas supplied to the fuel cell stack 6, the fuel cell stack 6, and the system controller 7 which controls these each part, and is constituted.

[0026] It comes to insert in each part with the gas conduction pipe which transmits hydrogen gas, hydrogen gas from the fuel storage cylinder 1 is led to the fuel cell stack 6, and it comprises such a fuel cell system so that the fuel cell stack 6 may be made to generate.

[0027] In a fuel cell system. Hydrogen gas from the fuel storage cylinder 1 via the regulator valve 2, the ejector pump 3, and the pressure sensor 5. The feeding passage 11 supplied to the fuel cell stack 6, the bypass passage 12 which leads hydrogen gas from the regulator valve 2 to the bypass valve 4 without supplying the ejector pump 3, and the cycle channel 13 which circulates through the hydrogen gas discharged from the fuel cell stack 6 to the ejector pump 3 are constituted.

[0028] In such a fuel cell system, it faces supplying hydrogen gas from the fuel storage cylinder 1 to the fuel cell stack 6, and either the feeding passage 11 or the bypass passage 12 is chosen by control of the system controller 7.

[0029] Although not illustrated, it has a pure tank for making the compressor for supplying air to the oxidizing agent pole of the fuel cell stack 6 as oxidant gas, and the fuel cell stack 6

circulate through purity, a pure-water-flows way, etc., and comprises this fuel cell system.

[0030]Below, the procedure by the system controller 7 in the fuel cell system constituted in this way is explained with reference to drawing 2.

[0031]According to drawing 2, first, according to the system startup instructions from the outside, the system controller 7 is outputting a control signal to each part, and carries out the execution start of the following processings (Step S1).

[0032]Next, the system controller 7 inputs the sensor signal which shows the present hydrogen gas pressure currently supplied to the fuel cell stack 6 from the pressure sensor 5, and the target hydrogen gas pressure made into the target supplied to the fuel cell stack 6 is obtained (Step S2). At this time, the system controller 7 holds the target hydrogen gas pressure to the present hydrogen gas pressure inside, and reads a target hydrogen-gas-pressure value to it.

[0033]Next, the system controller 7 calculates the pressure differential of the target hydrogen gas pressure and the present hydrogen gas pressure which were read at Step S2, and considers size comparison with the specified pressure value A as a pressure differential, and it is judged whether a pressure differential is larger than the specified pressure value A (Step S3). When it judges with a pressure differential being larger than the specified pressure value A, the system controller 7 judges with a passing flow rate when hydrogen gas is poured with the ejector pump 3 with target hydrogen gas pressure being excessive, and progresses to the following step S4. When it judges with the system controller 7 not having a pressure differential larger than the specified pressure value A, it judges with a passing flow rate when hydrogen gas is poured with the ejector pump 3 with target hydrogen gas pressure not being excessive, and returns to Step S2.

[0034]Next, the system controller 7 makes the bypass valve 4 an opened state (step S4), and only the predetermined value C increases the opening of the regulator valve 2 (Step S5). Thereby, the system controller 7 makes the hydrogen gas supplied to the fuel cell stack 6 simultaneously with opening of the bypass valve 4 increase gradually.

[0035]Next, the system controller 7 obtains the present hydrogen gas pressure with the pressure sensor 5 again, calculates the pressure differential of target hydrogen gas pressure and the present hydrogen gas pressure, and considers size comparison with the specified pressure value B as a pressure differential, and it is judged whether a pressure differential is smaller than the specified pressure value B (Step S6).

[0036]When it judges with the system controller 7 not having a pressure differential smaller than the specified pressure value B, it judges with the rise of the hydrogen gas pressure still supplied to the fuel cell stack 6 being insufficient, and it waits only for the fixed time t, and returns to Step S6 again (Step S7).

[0037]When it judges with the system controller 7 having a pressure differential smaller than the specified pressure value B, the hydrogen gas pressure supplied to the fuel cell stack 6

judges with having fully gone up, and closes the bypass valve 4 (Step S8).

[0038]Next, the system controller 7 closes the opening of the regulator valve 2 only the constant value C (step S9), When judging whether operation of a fuel cell system is suspended (Step S10) and suspending operation of a fuel cell system, processing is ended, and when not suspending operation of a fuel cell system, it returns to Step S2 again.

[0039]According to such a fuel cell system, the bypass valve 4 is formed in the bypass passage 12, Since hydrogen gas of a large flow rate can be supplied to the fuel cell stack 6 via the bypass passage 12 when it is necessary to supply much hydrogen gas to the fuel cell stack 6, While not enlarging the nozzle diameter of the ejector pump 3 in consideration of the time of a transitional large flow rate and being able to supply fuel gas with a sufficient response to the fuel cell stack 6, the circulation performance of hydrogen gas at the time of a low flow rate is also fully securable.

[0040]Since opening and closing of the bypass valve 4 are judged according to the difference of target hydrogen gas pressure and the present hydrogen gas pressure according to this fuel cell system, it can constitute only from forming the pressure sensor 5 in the upper stream which supplies hydrogen gas of the fuel cell stack 6, and a system can be constituted cheaply.

[0041]As above-mentioned Step S5 and step S9 explained, the system controller 7, When opening the bypass valve 4, while only a predetermined value raises the pressure value of hydrogen gas by the regulator valve 2, it controls so that only a predetermined value drops the pressure value of hydrogen gas by the regulator valve 2, when closing the bypass valve 4. Thereby, in a fuel cell system, mass supply and supply interruption of hydrogen gas can be performed with a sufficient response.

[0042]In an above-mentioned fuel cell system, the system controller 7, In Step S3, the pressure differential of target hydrogen gas pressure and the present hydrogen gas pressure, It may be controlled whether it judges whether a product with the present hydrogen gas pressure is smaller than the predetermined value A, and opening and closing of the bypass valve 4 are controlled, it judges whether the pressure differential of target hydrogen gas pressure and the present hydrogen gas pressure and a product with the present hydrogen gas pressure are smaller than the predetermined value B in Step S6, and the bypass valve 4 is closed.

[0043]Thereby, since the fuel cell system can control opening and closing of the bypass valve 4, taking the size of mass flow into consideration, it can raise control precision.

[0044]In an above-mentioned fuel cell system again the system controller 7, The pressure differential of the hydrogen gas pressure supplied to the ejector pump 3 in Step S3 and the present hydrogen gas pressure, It may judge whether it is larger than the predetermined value A, opening and closing of the bypass valve 4 may be controlled, and it may be controlled whether the pressure differential of the hydrogen gas pressure supplied to the ejector pump 3

in Step S6 and the present hydrogen gas pressure judges whether it is larger than the predetermined value B, and closes the bypass valve 4.

[0045]Thereby, according to the pressure differential of the upper pressure of the ejector pump 3, and the present hydrogen gas pressure, the fuel cell system can judge the amount of supply to the fuel cell stack 6, can become controllable according to the pressure loss before and behind the actual ejector pump 3, and can raise control precision.

[0046]In an above-mentioned fuel cell system again the system controller 7, The pressure differential of the hydrogen gas pressure supplied to the ejector pump 3 in Step S3, and the present hydrogen gas pressure, The pressure differential of the hydrogen gas pressure which judges whether a product with the present hydrogen gas pressure is larger than the predetermined value A, controls opening and closing of the bypass valve 4, and is supplied to the ejector pump 3 in Step S6, and the present hydrogen gas pressure, It may be controlled whether it judges whether a product with the present hydrogen gas pressure is larger than the predetermined value B, and the bypass valve 4 is closed.

[0047]A fuel cell system by this The pressure differential of the upstream pressure of the ejector pump 3, and the present hydrogen gas pressure, While being able to judge the amount of supply to the fuel cell stack 6 by a product with the present hydrogen gas pressure and becoming controllable according to the pressure loss before and behind the actual ejector pump 3, Since it becomes possible to control opening and closing of the bypass valve 4, taking the size of mass flow into consideration, control precision can be raised further.

[0048]Although an example mentioned above explained what is the channel which branched the bypass passage 12 from the downstream of the regulator valve 2, as shown not only in this but in drawing 3, the bypass passage 12 may be branched from the upstream of the regulator valve 2. In this case, by making it the on-off valve which has passage resistance fixed at the time of opening, the bypass valve 4 provided in the bypass passage 12 does not need to form the regulator valve 2, and can perform control of flow of the bypass passage 12.

[0049]As shown in drawing 4, may provide the regulator 2 for exclusive use and regulator 2' in each course as a course which made the main channel in which the ejector pump 3 was formed, and the bypass passage separate from the fuel storage cylinder 1, respectively, and become the part cost increase, but. Setting out of the regulator pressure which ****ed in the dynamic range of each flow rate range in the two above-mentioned channels is attained, especially accurate control of flow can be performed about the ejector pump 3 side.

[0050]By the fuel cell system mentioned above, while detecting the hydrogen-gas-pressure value supplied to the fuel cell stack 6, have specified as what supplies a target hydrogen-gas-pressure value to the fuel cell stack 6, but. It is good also as the hydrogen-gas-pressure value of not only this but fuel cell stack 6 inside, and a hydrogen-gas-pressure value discharged from the fuel cell stack 6.

[0051]Although the fuel cell system explained an example provided with the fuel storage cylinder 1 as a mechanism in which hydrogen is stored, not only this but a liquid hydrogen storage tank and a hydrogen storing metal alloy may be used.

[Translation done.]